

The Assistant Commissioner for Patents**The Invention**

The present invention is based on the finding that alkaline darkening of a mechanical pulp in the presence of calcium carbonate filler is inhibited by incorporating a sulfite in the pulp suspension.

The examples in the specification clearly demonstrate the effect of sulfite in inhibiting darkening of the pulp in the alkaline environment resulting from the presence of the calcium carbonate filler.

Inhibition of darkening as in the present invention is different from, and should not be confused, with brightening or bleaching of pulp. These are two distinctly different concepts.

Inhibition of Alkaline Darkening v Bleaching or Brightening

Based on the rejections raised in the Office Action, it appears that two distinct concepts have been equated, namely bleaching (or brightening) and inhibition of darkening.

Bleaching or brightening involves the chemical elimination of existing chromophores in a pulp in order to obtain an increase in brightness. **In contrast**, inhibition or prevention of darkening stops or reduces the production of **new chromophores** such as those induced by alkalinity. In other words, inhibition prevents or reduces a drop in the original brightness of the pulp, but does not cause an increase in the brightness of

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the original pulp, while bleaching (or brightening) serves to obtain a **higher** brightness than that of the original pulp.

Example V and Table 3 in the specification serve to illustrate the difference between the darkening inhibition in accordance with the invention and bleaching or brightening as in the prior art.

In the procedure of Example VI pulp with or without darkening inhibition using sulfite, was bleached subsequently with hydrosulfite.

Before using the technology of the invention (darkening inhibition), the brightness of the pulp was lowered by 2 to 3 points due to alkaline darkening caused by the calcium carbonate filler. **This brightness loss could not be regained by the subsequent bleaching stage.**

By adding sulfite before darkening occurred, in accordance with the invention, **the alkaline darkening was inhibited**, and because of this inhibition, **the pulp maintained its brightness** as if the pulp had been in an acid medium. The subsequent bleaching was then able to **further improve the brightness** to the target level.

Following the procedure of Example VI, most alkaline darkening was inhibited by the addition of 0.5% sodium sulfite to the latency chest. In further tests, full inhibition of darkening occurred at 1% sodium sulfite and the pulp maintained its brightness as if the pulp had been in an acid medium. A subsequent bleaching was able to further improve the brightness to 62.3%.

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Appendix A attached hereto includes additional Examples VII and VIII which further illustrate the invention and the difference between alkaline darkening inhibition, and bleaching (or brightening).

In Example VII, a TMP was treated with calcium carbonate. In the absence of sulfite, the brightness of the pulp **decreased** from 57.6 to 54.6% because of alkaline darkening. When 1% sulfite was present during the calcium carbonate treatment, the final brightness was 57.5% because sulfite inhibited alkaline darkening. However, when 1.5% sulfite was added to the alkaline-darkened pulp the brightness increased only to 55.7% from 54.6%. Clearly, the brightness loss due to alkaline darkening **cannot** simply be regained by bleaching, even with a **higher** sulfite dosage, 1.5% in this case (as compared with 1% to inhibit alkaline darkening).

This indicates that sulfite is more efficient as a darkening inhibitor than as a brightening or bleaching agent. If sulfite functioned only as a bleaching agent to eliminate the **existing** chromophores, then one would expect that when sulfite was added to the darkened pulp, it should have **gained more** brightness because there were more chromophores there to react. However, the results showed the opposite. Therefore, bleaching (or brightening) and darkening inhibition are two completely different concepts. The function of sulfite according to the present invention is darkening inhibition, not bleaching or brightening, and this function of darkening inhibition is new and not suggested in the prior art.

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In addition, the inventors found that even though sometimes bleaching or brightening process may eliminate the chromophores generated by alkaline darkening, a **higher** chemical dosage was required than with inhibition of darkening. In one trial, (Example VIII), alkaline-darkening of a TMP was inhibited with 0.9% sulfite. This inhibition led to a pulp brightness of 57.2% after the subsequent bleaching stage with 0.4% hydrosulfite. When the darkening was not inhibited by sulfite, the subsequent bleaching stage required a **double** amount of hydrosulfite (0.8%) to reach the same brightness target. This again shows that the darkening inhibition of sulfite cannot be explained by its brightening effect.

Prior art relating to the use of sulfite as a brightening agent to raise the brightness of a pulp from its original value is completely irrelevant to the use of a sulfite, in accordance with the invention, to inhibit alkaline darkening which serves to prevent lowering of the original brightness of the pulp.

With the aforementioned distinction in mind, the rejections set forth in the Office Action are considered in turn.

WO 96/20308 in View of Eckert or Evans et al

Claims 1 to 7, 10, 11 and 20 to 25 stand rejected under 35 U.S.C. over WO 96/20308 in view of Eckert or Evans et al.

Drummond (WO 96/20308) is clearly concerned with **bleaching** of filled paper. More especially, a paper that has been darkened **previously** due to calcium carbonate (see

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page 2, lines 17 to 26 of Drummond). In Drummond, the bleaching chemical is not added to **stop** the production of chromophores, but rather to remove the chromophores **already produced** by darkening. This is completely different from the present invention for the reasons outlined above. Consequently, modifying the bleaching agent based on the separate teachings of Eckert does not result in the present invention. Neither reference alone or in combination suggests that sulfites will **inhibit** alkaline darkening.

The separate reliance on Evans et al is not understood. Evans et al has been discussed in the proceedings of the parent application and it is not evident why this reference continues to be misrepresented. Evans et al do not suggest, in any way, that a sulfite inhibits alkaline darkening. Rather, in Evans et al, darkening is reduced or avoided by removal of the alkaline material that produces the darkening, which in Evans is caustic soda. Evans et al is concerned with de-inking of waste paper. In such de-inking, caustic soda is customarily employed to provide alkalinity to promote fiber swelling, causing the ink to separate from the paper fibers. As noted by Evans et al, caustic soda has the disadvantage that it embrittles the fibers and also causes alkaline darkening. Evans et al thus replaced the caustic soda (responsible for the alkaline darkening) by a combination of sodium sulfite and sodium carbonate. Thus, Evans et al avoid alkaline darkening by removing the reagent that was producing such darkening, namely the caustic soda. This is not a teaching that sodium sulfite and sodium carbonate alone or together inhibit alkaline darkening. Furthermore, modifying Drummond by replacing his bleaching agent by sodium sulfite and sodium carbonate does not result in the

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present invention and, indeed, there is no basis for such replacement, Evans et al being concerned with a problem unrelated to the problem of Drummond.

With respect to the comment that the order of addition has not been shown to be critical, it is clear from the description that the sulfite is to be added initially so as to inhibit the darkening which results from the alkaline environment developed by the calcium carbonate.

Reconsideration is requested.

Tsukamoto et al

Claim 8 is rejected under 35 U.S.C. 103 as being unpatentable over WO 96/20308 in view of Eckert or Evans et al and further in view of Tsukamoto et al.

First, Tsukamoto et al does not overcome the basic deficiencies of Drummond with Eckert or Evans et al.

Tsukamoto et al is not concerned with inhibition of alkaline darkening, rather it is concerned with the use of a brightening agent to elevate the brightness of wood pulp. The brightening agent is a sulfonating compound and various such compounds are identified including sulfites.

Tsukamoto et al is apparently relied on to show adjustment of pH during bleaching with an acid or a buffering agent. The present invention is not concerned with

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bleaching as outlined above. The present invention is concerned with inhibition of alkaline darkening, a totally different concept.

Furthermore, claim 8 in the present application depends from claim 6 which defines a pH of 6.5 to 9. Tsukamoto et al only teaches a buffer agent for the case in which a sulfite is employed, for a different pH range, namely 10 to 13.

It is not seen that Tsukamoto et al has any relevance to the invention claimed.

Nye and EP 608 687

Claim 9 stands rejected under 35 U.S.C. 103 as being unpatentable over WO 96/20308 in view of Eckert or Evans et al and further in view of Nye or EP 608 687.

Nye and EP 608 687 do not overcome the basic deficiencies in the primary and secondary references as discussed above. Furthermore, they are both concerned with bleaching or brightening and not with inhibition of alkaline darkening. These are distinctly different concepts as outlined above.

Admitted Prior Art

Claim 12 stands rejected in view of the primary and secondary references considered above and further in view of admitted prior art. The so-called admitted prior art does not overcome the deficiencies of the primary and secondary references. None of the references is concerned with inhibition of alkaline darkening, and as such, is irrelevant to the present invention.

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Reconsideration is requested.

Hovey and Tsukamoto et al

While reference is made to Hovey in the Office Action, in the list of references, Hovey is identified as U.S. Patent 2,173,687 which is incorrect. The latter U.S. Patent is concerned with a mower cutting structure. It is assumed, therefore, that the Examiner intended to identify the Hovey reference which was identified in the proceedings of the parent application and which has been discussed at length previously.

It is indicated that Hovey teaches incorporating mechanical pulp with calcium carbonate filler to inhibit the alkaline darkening of the pulp. This finding is totally erroneous as has been pointed out previously. Calcium carbonate does **not** inhibit alkaline darkening, and Hovey does not teach that it does. On the contrary, it is well known and recognized by Hovey that calcium carbonate causes alkaline darkening.

In fact, it has been long since calcium carbonate was discovered to cause alkaline darkening as evident by Hovey's Patent in 1937:

"when carbonate filler is employed with groundwood pulp the alkalinity of the filler causes an additional discoloration of the groundwood" (page 2, left column, lines 27-33).

This darkening effect restricts the use of "...calcium carbonate" in mechanical pulp (Drummond, page 2, lines 10-12).

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Tremendous effort has been spent to limit the darkening effect, for example, by reducing pH (U.S. Patent 5,043,017 and 5,505,819), by bleaching (WO 96/20308), and by a high filler level (U.S. Patent 2,173,167). However, these methods suffer many limitations.

At present, alkaline darkening remains the one key reason why low-cost and bright calcium carbonate is not widely used in papermaking with mechanical pulps. Until the present invention, there had been no economic and easy method to inhibit alkaline darkening.

As indicated in the proceedings of the parent application, Hovey seeks to overcome the alkaline darkening by employing excess calcium carbonate filler to **mask** the darkening. This is **not** inhibition of the darkening, the darkening occurs and remains but is obscured or masked by the excess of white calcium carbonate filler.

Tsukamoto et al employs a bleaching and contains nothing of assistance with respect to preventing or inhibiting alkaline darkening. In fact, as noted above, Applicant's trials demonstrate that the effects of alkaline darkening cannot simply be overcome by employing the sulfite in a subsequent bleaching.

Combining Hovey and Tsukamoto, even if such combination could be made, does not result in the present invention.

Nye and EP 608 687 are additionally relied on in the rejection of claim 9, however, they do not overcome the deficiencies of the primary and second reference. Similarly,

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the reliance on the so-called admitted prior art in the rejection of claim 12 does not overcome the basic deficiencies of the primary and secondary reference.

Reconsideration is requested.

None of the references relied on contains **any** teaching of inhibition of the darkening which results from calcium carbonate as filler in mechanical pulp or indeed **any** other alkaline agent.

It is believed that the invention is clearly distinguished over the art, none of which is relevant. If the Examiner intends to maintain the position that bleaching is somehow equivalent to inhibition of alkaline darkening, then it is requested that the scientific or technical basis, relied on for such finding be identified so that Applicant can answer further. It is Applicant's position that these two concepts are in no way the same as outlined above.

The use of sulfite according to the present invention to inhibit alkaline darkening caused by calcium carbonate filler in mechanical pulp is distinct from the use of sulfite for its brightening or bleaching effect. No prior art known to Applicant, including that relied on in the present Office Action and the earlier Office Actions, in any way teaches this important discovery.

The application is believed to be in condition for allowance and early and favorable action would be appreciated.

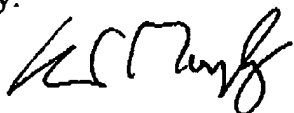
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Respectfully,

X. HUA et al

By:



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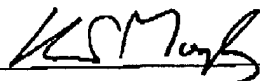
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Appendix A

Example VII

This example demonstrates the distinction between darkening inhibition effect of sodium sulphite according to this invention, and the brightening effect as known in the prior art.

A TMP was treated with calcium carbonate in the presence and absence of sodium sulphite. In the absence of sulfite, the brightness of the pulp decreased from 57.6 to 54.6% because of alkaline darkening (Table 4). When 1% sulfite was presented during the calcium carbonate treatment, the final brightness was 57.5% because sulfite inhibited alkaline darkening. However, when 1.5% sulfite was used to brighten the alkaline-darkened pulp, the brightness increased only to 55.7% from 54.6%. Clearly, the brightness loss due to alkaline darkening cannot simply be regained by bleaching, even with a higher sulfite dosage in the bleaching stage, 1.5% in this case. The darkening inhibition effect of sulphite in this example was rather unexpected. If sulfite did not inhibit alkaline darkening, and functioned only as a bleaching or brightening agent to eliminate the existing chromophores, then we would expect that when sulfite was used to bleach the darkened pulp, it should have gained more brightness because there were more chromophores there to react. However, our results showed the opposite. Therefore, the function of sulfite according to our invention is darkening inhibition, not bleaching or brightening.

Table 4. TMP brightness under neutral and acid conditions w/o sodium sulphite.

Pretreatment with PCC in the presence and absence of sulphite		Subsequent brightening with sodium sulphite	Handsheets
pH	Na ₂ SO ₃ %	Na ₂ SO ₃ %	Brightness %
5.3	0	N/A	57.6
7.0	0	N/A	54.6
7.0	1	N/A	57.5
7.0	0	1	55.5
7.0	0	1.5	55.7

Example VIII

This example shows that even though bleaching or brightening process may eliminate some of the chromophores generated by alkaline darkening, a much higher chemical consumption is required to reach a target brightness in comparison to that when the darkening is inhibited according to our invention. In this example, alkaline-darkening caused a brightness drop from 58.2 to 55.7 after bleaching with 0.4% hydrosulphite (Table 5). When the darkening was inhibited with 0.9% sulfite, the pulp brightness increased to 57.2% after the subsequent bleaching stage under the same conditions. In the absence of sulfite, the subsequent bleaching stage required a double amount of hydrosulphite (0.8%) to reach the same brightness target, which is very costly because the bleaching agent is expensive. Please note that when sulphite was used under acidic conditions, pH 5.4 in this case, the brightness gain was much smaller because there was no alkaline darkening. The sulfite used under acidic conditions functioned only as brightening agent. Obviously, the darkening inhibition of sulfite cannot be explained by its brightening effect.

Table 5. The brightness of TMP bleached with hydrosulphite before and after a pre-treatment with sodium sulphite. The pH was adjusted with sodium phosphate.

Pretreatment with PCC in the presence and absence of sulphite, 2 hours, 82°C		Bleaching with hydrosulphite at 3.6% cs., 60°C for 40 min.	Handsheets
pH	Na ₂ SO ₃ %	Sodium hydrosulphite %	Brightness %
No any treatment or bleaching			53.9
5.4	0	0.4	58.2
5.4	0.9	0.4	58.7
7.0	0	0.4	55.7
7.0	0.9	0.4	57.2
7.0	0	0.8	57.2
7.0	0	1.2	57.7

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